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NOTES ON THE PREDACEOUS THRIPS *HAPLOTHRIPS SUBTILISSIMUS* HAL. AND *AEOLOTHRIPS* *MELALEUCUS* HAL.*

BY WM. L. PUTMAN,

Dominion Entomological Laboratory, Vineland Station, Ontario

Haplothrips subtilissimus Hal.

During a study of the predators of the oriental fruit moth (*Grapholitha molesta* Busck), the thrips *Haplothrips subtilissimus* (Hal.) was found destroying the eggs of the moth and also those of European red mite (*Paratetranychus pilosus* C. & F.). As the habits of predaceous thrips in general were little known and as some knowledge of the status of this species as a fruit moth predator was desirable, investigations on the biology of the species were carried on in the insectaries at St. Davids and Vineland Station, Ontario, in the years 1932 to 1935, while field studies were made in various peach orchards in the Niagara Peninsula. Dr. J. B. Steinweden of the California Department of Agriculture identified the species and later sent some of the material to Mr. J. C. Crawford of New York, who confirmed the determination.

According to Dr. Steinweden (in litt.), Priesner (9) states that *H. subtilissimus* is widely distributed through Europe and northern and central Asia. The species has apparently been established in Ontario for a number of years as it is common in many parts of the Niagara Peninsula. The only other North American record appears to be that of Blanton (4) from Long Island, New York, whose specimens were determined by J. C. Crawford.

DESCRIPTION OF STAGES

Adult. Shining black; third to sixth antennal segments pale brownish yellow, seventh and eighth fuscous; apices of fore tibiae pale. Length averages about 2.3 mm. A technical description is given by Priesner (9).

Egg. Orange, 0.41 x 0.13 mm.; elongate-elliptical and slightly curved, a rounded and somewhat flattened raised pale area at the micropylar end.

First Instar Larva. Pale yellow, the prothorax tinged with reddish and with two pale smoky dorsal sclerites; head and appendages pale smoky, eyes dark red. Seventh and eighth abdominal segments red or orange of varying intensity, ninth and tenth red more or less obscured by fuscous.

Second Instar Larva. Pale yellow; head fuscous with underlying red pigment; prothorax red with two fuscous sclerites on dorsum. Metathorax, and third, fourth, seventh and eighth abdominal segments carmine red, eighth with lateral fuscous sclerites; ninth and tenth dark reddish fuscous. Appendages pale smoky. Length about 1.25 mm. The distribution of the red pigment agrees with Bagnall's description (1).

Prepupa. Of typical thysanopteran type, with short porrect antennae and scarcely evident wing pads. Body with diffuse red pigment; appendages clear glassy white.

Pupa. Colour as in prepupa. Antennae longer, eight-jointed and folded laterally along the head; wing pads reaching nearly to fifth abdominal segment.

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LIFE HISTORY

Haplothrips subtilissimus was easily reared in the insectary, individuals being confined in small glass vials with gauze-covered cotton stoppers. As a high humidity was necessary for normal development the vials were kept in jars containing a layer of plaster of paris which was moistened occasionally. Both larvae and adults were fed on eggs of the oriental fruit moth supplied on bits of peach leaf or waxed paper. Eggs of the Mediterranean flour moth (*Ephestia kuehniella* Zell.), or in early spring, eggs of various aphids were occasionally substituted. All rearing was carried on in screened insectaries.

The species appears to be strictly parthenogenetic, as the progeny of one female was reared through six generations without the appearance of males, and this sex was never found in the orchards. Winter is spent in the adult stage. There appear to be normally four generations during a season, but some adults of the third and possibly a few of the second hibernate. The duration of the different stages, based on 68 individuals reared during 1933 and 1934, is briefly summarized in the following table. As very few of the first generation were reared little data was secured on the rate of development in spring; in late fall all stages were much prolonged.

DEVELOPMENT OF *HAPLOTHRIPS SUBTILISSIMUS* HAL.

	Season		Midsummer—July 1 to Aug. 15	
	Days	Extremes.	Average.	Days
Incubation Period	4-13			6.2
First Larval Period	2-9			4.5
Second Larval Period	2-14			4.9
Prepupal Period	less than 1-4	less than 1-4		0.8
Pupal Period	3-43		3-7	5.0

The complete developmental period required 18 to 77 days; for thrips from eggs laid June 21 to July 30 it averaged 21.6 days, and from those laid during August, 27.5 days. In late fall the period was greatly prolonged, many individuals being killed by cold before completing their development.

Adults of the summer generations lived from 30 to 52 days during midsummer, but much longer during cooler weather in fall. The number of eggs laid by summer brood adults kept at a humidity approaching saturation ranged from 66 to 173, nine individuals averaging 129 eggs each. In a drier atmosphere egg production was greatly reduced. The most prolific of the few overwintering females available deposited 68 eggs. Oviposition normally commenced within three or four days after maturity in warm weather and continued to within a day or two of death of the female. An average of about three eggs was deposited daily, although an occasional female laid as many as five on very warm days.

The adults were successfully carried through the winter of 1934-35 by inverting the rearing vials on the earth floor of the insectary and covering them with an inverted flower pot. With no further protection they withstood temperatures well below zero, whereas another lot left on an insectary shelf were all dead early in the winter, apparently from lack of moisture. While only about 15 females were overwintered, a number too small to permit much generalization, the length of life in the spring appeared to be influenced by the time of maturity in the previous fall. Adults maturing early in September, including two which had laid a few eggs later in the fall, hibernated successfully but died in April without producing eggs in the spring, whereas the last to mature, in late October, lived until June 29 and was the most prolific of the lot.

The thrips became active during the first warm days of March, but feeding was not noticed until early April. In 1935 the first egg was laid by an overwintered female on April 27 and the last on June 28. As only one individual

of the first generation was reared in 1934, the full extent of this generation was not determined. All generations overlapped to such an extent that they were indistinguishable in the field. Breeding continued until late in the season, eggs being deposited in both 1933 and 1934 until the end of September. Eggs laid after about September 20 did not hatch, and larvae hatching after approximately the same date did not mature, although they lived until killed by severe freezing temperatures in late November. Adults of both the third and fourth generations hibernated; possibly some of the second would have overwintered if a full generation had been reared. The seasonal life history is shown graphically in Fig. 1, based on insectary rearing. It should be noted that all the thrips reared in 1934 were the progeny of a single first generation female and hence do not represent the normal span of the various generations.

HABITS

The normal hibernating quarters of *Haplothrips subtilissimus* were not located. Quantities of rough bark scraped off the trees in winter were unsuccessfully examined, a result scarcely unexpected as the maintenance of an adequate moisture supply appears essential for survival. A more favourable situation would probably be found among fallen leaves or other soil debris.

During the summer the adults were commonly found moving rather slowly

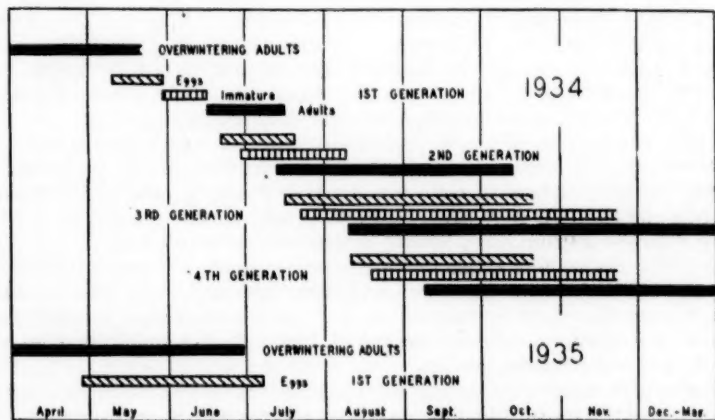


Fig. 1. Life History of *Haplothrips subtilissimus* Hal.

over the leaves or twigs or resting between leaves, in the axils, or other places where they were more or less concealed. It was noticed that those in the rearing vials generally hid beneath pieces of leaf when not feeding. While this species will run rather swiftly when disturbed or kept without food, it is, in common with other Tubulifera, much less active than the more familiar plant-feeding thrips of the suborder Terebrantia. Although the wings are well developed, adults very seldom took flight when disturbed.

Eggs deposited in the rearing vials were glued lightly between the meshes of the gauze covering the stoppers; the only egg noticed in the orchards was inserted within an empty lepidopterous egg-shell. The habits of the larvae were essentially the same as those of the adults, both instars being frequently encountered on peach foliage. The prepupae and pupae were normally quiescent but attempted to crawl in a clumsy manner when disturbed. The former were not encountered in the orchards, but a few pupae were found between leaves webbed together by spiders and in one case, within the split pit of a fruit. More

may have been concealed in rough bark or possibly on the soil, as a relatively high humidity appeared to be essential for this stage.

HOSTS AND FEEDING HABITS

As *H. subtilissimus* is apparently strictly predaceous, it may be expected to occur on any plant bearing suitable prey. Bagnall records it from oak and elm, and Blanton from a number of herbaceous plants. The writer found it common on peach, and also took a few specimens from a mite-infested plum tree; lack of time prevented a more extended search.

Eggs of various insects and mites appear to constitute the greater part of the food of this thrips. Both larvae, and adults were seen feeding on eggs of the oriental fruit moth, European red mite, and common red spider (*Tetranychus telarius* L.) in the orchards, and they readily accepted eggs of the Mediterranean flour moth, various aphids, and oyster shell scale (*Lepidosaphes ulmi* L.) in the rearing vials. They also destroyed eggs of their own species in the absence of other food. Those observed by the writer showed no inclination to attack active stages of any species, and indeed their feeding habits are poorly adapted for the capture of such forms, their legs not being used to grasp the prey, as they are by the larvae of *Aeolothrips melaleucus* Hal. to be discussed later. The quiescent or fixed nymphs of the cottony peach scale (*Pulvinaria amygdali* Ckll.), European fruit lecanium (*Eulecanium corni* Bouche) and whitefly (*Trialeurodes vaporariorum* Westw.) were likewise apparently not attacked under insectary conditions. However, the occurrence of cannibalism among nymphs of *H. subtilissimus* when confined without food indicated that they were able to overpower active prey when other food was lacking, and the remains of mites were found where the thrips was the only predator present.

Close observation of larvae and adults supplied with oriental fruit moth eggs showed that the food was apparently located by chance and recognized only by contact. After the mouth cone was applied to an egg the thrips remained quiet while the contents were slowly sucked. Only a small portion of the latter could be removed at one time, leaving a dimple-like depression on the surface of the egg, but the same or other thrips frequently continued to feed at intervals on one egg until the contents were completely removed. For this reason the number of eggs destroyed by one thrips in a given time varied greatly; from 8 to 16 were fed upon during the period of larval development, and an adult usually sucked one to three per day.

Bailey (3) states that *Leptothrips mali* Fitch, a predaceous species very similar to *Haplothrips subtilissimus*, feeds to a large extent on eriophyid mites. The silver leaf mite, *Phyllocoptes cornutus* Banks, was occasionally very abundant in the orchards under study, but *H. subtilissimus*, was never noted in unusual numbers on trees infested with this eriophyid.

PREVALENCE IN PEACH ORCHARDS

Haplothrips subtilissimus was found in small numbers in all of the four peach orchards, located at St. Davids, Niagara-on-the-Lake, Vineland Station and Grimsby, Ontario, which were used as observation points for a study of oriental fruit moth predators. In 1932 only general observations were made on the species, but in 1933, 1934 and 1935 all larvae and adults were recorded during the weekly time counts. Approximately a thousand leaves were carefully examined during each count of one hour and the number of oriental fruit moth eggs and all stages of other insects were recorded. Duplicate examinations on both old and young trees were made at each point from about June 1 to September 20, covering a period of 16 or 17 weeks.

The very small numbers of *H. subtilissimus* usually found is indicated by the fact that only 214 individuals of all stages were noted on mature trees during

all of the counts, totalling 196 hours, during the three-year period. As this thrips appears to seek concealment when not feeding, those observed undoubtedly represent only a portion of the population actually present in the orchards. It was soon noticed that where unusually large numbers of *H. subtilissimus* were present, European red mite was also abundant. Although a few mites may be found on many trees, heavy infestations seldom develop on peaches except on some varieties, notably on South Haven, and frequently only on certain trees. Such trees always bore the greatest number of thrips. In 1932 a few trees in an orchard at St. Davids which were badly attacked by the mite supported the largest population of *H. subtilissimus* that the writer encountered; as many as 80 could be found during one-hour examinations. While such numbers were never met with in the observation orchards, all of the larger counts were made where the mite was abundant, notably at Grimsby in 1934, where two to sixteen were found per hour after midsummer, whereas four was the maximum count in the other orchards. The presence of mites did not necessarily mean that thrips were common; the latter were always scarce at Niagara-on-the-Lake although some trees were at times heavily mite-infested. The greater abundance of *H. subtilissimus* on mite-infested trees may have been due to a particular preference for the mite as food, or more probably because the latter was the only suitable prey that was ever sufficiently abundant to support a large population. Both larval and adult thrips were often encountered on trees where European red mite was not present.

Haplothrips subtilissimus was generally less prevalent on young trees than in mature orchards, probably because red mite was less common. The only young observation orchard with appreciable numbers of thrips was that at St. Davids in 1933, which was interplanted with raspberries infested with common red spider on which the thrips were feeding. *H. subtilissimus* was occasionally found attacking the eggs in colonies of red spider on peach trees, but red spider was always too scarce on this host to allow a large population of thrips to build up.

Larvae usually occurred in about the same numbers as adults; an exception was noted at Grimsby in 1934, where the abundant food supply on trees infested with European red mite had apparently stimulated reproduction so that larvae predominated.

Both adults and larvae were present, although very scarce, at the beginning of June when field work began each season and were still active in late September at its termination. In all three years, the thrips were fewest about June 20, but owing to the small numbers found throughout this month, it was not certain whether this apparent low point in the population trend was of any real significance. In 1934 and 1935 this was followed by a rapid build-up to a maximum between July 20 and August 3, after which the population declined to about half the maximum. The period of increase coincided with growth of the European red mite population, but the numbers of thrips declined more rapidly than those of the mite, indicating that factors other than lack of prey may limit the thrips population. In 1933, when European red mite was comparatively scarce, *H. subtilissimus* increased much more slowly to a maximum on August 17.

IMPORTANCE OF HAPLOTHRIPS AS A PREDATOR OF THE EUROPEAN RED MITE

To show the possible value of *H. subtilissimus* in the natural control of European red mite, the potential rates of increase of the two species may be compared. Data on the mite is taken from Ross and Robinson's (10) study of this species on plum at Vineland Station and refers to the third generation, developing during June and July. Data for the thrips represent the average midsummer rate of development.

	<i>P. pilosus</i> C. & F.	<i>H. subtilissimus</i> Hal.
Incubation period	7.0 days	6.2 days
Combined larval, nymphal or pupal periods	8.0	14.9
Preoviposition period	3.0	3.0
Complete life cycle	18.0 days	24.1 days
Maximum number of eggs per female	90	173

P. pilosus has the more rapid rate of development, the complete life cycle requiring only 18 days as compared with approximately 24 for *H. subtilissimus*. The latter, however, produces nearly twice as many eggs, all of which develop into females, whereas a certain variable proportion of the mite eggs produces males. The rate at which females oviposit, about three eggs per day, is approximately the same in both species. It is apparent that *H. subtilissimus* has considerably the greater potential rate of increase and theoretically should be an efficient enemy of the mite. Actually it was never more than a minor predator, which never attained the importance of *Stethorus punctum* Lec. or *Seiulus* sp. Both of these predators, as well as the host, possess a great advantage in that their entire life cycle is passed on the foliage, whereas the larvae of *H. subtilissimus* must seek a humid, sheltered location in which the prepupal and pupal periods may be passed.

Both Garman (5) in Connecticut and Gilliat (7) in Nova Scotia mention *Haplothrips* sp. as a minor predator of the European red mite. Gilliat's description of the larva indicates that his species was either *subtilissimus* or a very closely related form. It is of interest that neither *Scolothrips sexmaculatus* Perg. nor *Leptothrips mali* Fitch, both well-known predators of mites in the United States, according to Bailey (2, 3), were observed during the writer's studies. A single maroon-coloured larva which may have been *mali* was found feeding on common red spider (*Tetranychus telarius* L.), but the adult, reared to maturity on oriental fruit moth eggs, was lost before it could be identified. Treherne (11) lists *Leptothrips mali* from Vineland, Ontario, but there are apparently no records of *Scolothrips sexmaculatus* north of New York.

IMPORTANCE AS AN ORIENTAL FRUIT MOTH PREDATOR

Attacks of *Haplothrips subtilissimus* on oriental fruit moth eggs were first brought to the writer's attention in 1932, in the mite-infested orchard at St. David's previously mentioned. In the course of some experiments on oriental fruit moth biology, leaves bearing numbers of moth eggs were inadvertently pinned on trees with a very high mite population. When the eggs were examined a few days later, over 70 per cent were found to have been destroyed by predators, which later observation showed to be *Haplothrips subtilissimus*, together with the mite *Anystis agilis* Banks. Eggs deposited normally on the trees would probably not have been so heavily attacked, as the thrips took shelter between the leaves which were pinned together and remained until the eggs were consumed.

The occasion just mentioned was the only one noted when *H. subtilissimus* was sufficiently numerous to have any appreciable influence on the oriental fruit moth. A few thrips were seen attacking the eggs at other times, and small numbers of partially sucked eggs, presumably the work of this species, were noticed in most of the observation orchards, but its importance as a predator of the fruit moth ranked considerably below that of chrysopids. Garman (6) and others have made brief references to thrips attacking the oriental fruit moth, but they have apparently never been considered of any importance.

Aeolothrips melaleucus Hal.

Larvae and adults of another predaceous thrips, *Aeolothrips melaleucus* Hal., were occasionally encountered in the observation orchards. This is also

a European species, first recognized in North America by Moulton (8) who recorded it from British Columbia in 1929. The larvae were found only in association with red spider or occasionally with European red mite, but the adults were more generally distributed. The greatest numbers found in any one season were 27 larvae and 12 adults in 1934.

In comparison with *Haplothrips subtilissimus*, the larvae of *A. melaleucus* were very active, with quick nervous movements. When feeding, they seized the mites and manipulated them beneath the mouth cone by means of the fore legs while the contents were sucked out. All stages of both species of mites were attacked. The larvae also fed freely and reached maturity on oriental fruit moth eggs in the insectary. Adults were not seen feeding in the orchards and could not be induced to do so in confinement.

On maturity, the larvae spun white oval cocoons in the bottom of the rearing vials, the silk being spun from the anus. As the adults always died after two or three days in confinement without producing eggs it was not possible to investigate the life history of the species. It appeared to be of little importance as a predator of mites or of the oriental fruit moth.

SUMMARY

The predaceous thrips, *Haplothrips subtilissimus* Hal. was found generally distributed but seldom abundant in peach orchards in the Niagara Peninsula of Ontario, occurring in greatest numbers on trees infested with European red mite. Eggs of this mite and the common red spider were attacked, as well as those of the oriental fruit moth and other insects. Data on various phases of the life history were obtained. There were four generations per year, only one or two of which were complete, and the adults hibernated. Reproduction was thelytokous, males not being found during the study. The species was of minor importance as a predator.

Another predaceous species, *Aeolothrips melaleucus* Hal., was occasionally found attacking mites in peach orchards.

REFERENCES

1. Bagnall, R. S. A. 1933. A contribution towards a knowledge of the thysanopterous genus *Haplothrips* Serv. Ann. & Mag. Nat. Hist. 11:313-334.
2. Bailey, S. F. 1939. The six-spotted thrips, *Scolothrips sexmaculatus* (Perg.). J. Econ. Ent. 32: 43-47.
3. Bailey, S. F. 1940. The black hunter, *Leptothrips mali* (Fitch) J. Econ. Ent. 33:539-544.
4. Blanton, F. S. 1939. Notes on some thrips collected in the vicinity of Babylon, Long Island, N. Y. J. New York Ent. Soc. 47:83-94.
5. Garman, P. 1923. The European red mite. Connecticut Agr. Expt. Sta. Bull. 252.
6. Garman, P. 1930. The oriental peach moth in Connecticut. Connecticut Agr. Expt. Sta. Bull. 313.
7. Gilliat, F. C. 1935. Some predators of the European red mite, *Paratetranychus pilosus* C. & F., in Nova Scotia. Can. J. Res. D, 13:19-38.
8. Moulton, D. 1929. Two new species of *Lispthrips* Reuter from Canada, with notes on other species. Can. Ent. 61:286-287.
9. Priesner, H. 1928. Die Thysanopteren Europas. Wein.
10. Ross, W. A., and W. Robinson. 1922. Notes on the plum spider mite or European red mite. 52nd Annu. Rept. Ent. Soc. Ont., pp. 33-42.
11. Treherne, R. C. 1924. Thysanoptera known to occur in Canada. Can. Ent. 55:82-88.

FOUR NEW SPECIES OF *MESAMIA* (HOMOPTERA, CICADELLIDAE) *

BY R. H. BEAMER,

University of Kansas, Lawrence, Kans.

***Mesamia obtusa* n. sp.**

Resembling *M. prescotia* Ball but with vertex margins meeting at distinctly more than a right angle. Length 4 mm.

Vertex flat slightly excavated, almost one-half wider between eyes than length at middle, margins slightly curved out, meeting at distinctly more than a right angle.

Color. Buff, margins of vertex white or yellow, margined with fuscous line above and below, remainder buff with lighter basal median transverse spot; pronotum mottled; scutellum with basal angles darker; elytra with veins numerous, darker with numerous lighter areoles.

Genitalia. Valve of male obtuse angled, almost hidden beneath last ventral segment; plates about as wide at base as valve, evenly narrowed to sharp apices; about one-third longer than wide. Pygofer of male almost rectangular with a short blunt hook on outer ventral corner; aedeagus in dorso-ventral view broad, ribbon-like, curved dorso-anteriorly in half circle on basal third, abruptly narrow to one-third its width at apex; a broad basal sheath extends to middle of basal curve, sides of sheath extend out and around shaft in a sharp pointed projection; the normal processes are broader than shaft of same length, extend in close contact with shaft, contracting to sharp needle points.

Holotype male and 1 *paratype* male, Sabino Canyon, Arizona, August 14, 1932, R. H. Beamer. Types in the Snow Collection, University of Kansas.

***Mesamia vermiculata* n. sp.**

Resembling *M. nervosus* Osb. but dark line on margin of vertex broken only at middle, pygofer hook short and stout and processes of aedeagus broad, forming a shield about shaft. Length 4-5 mm.

Vertex flat, slightly excavated, lateral margins rounded, meeting at more than a right angle. Recurrent veins to costa and other veins in elytra numerous.

Color. Yellowish gray often tinged with green; vertex with margin light margined with fuscous either side, dorsal line broken medianly; pronotum with front third lighter; scutellum with apex and basal angles darker; elytra with veins darker, clavus and portion of corium with vermiculate marks; venter light tinged with green.

Genitalia. Last ventral segment of female about twice as long as preceding segment, lateral margins rounded, posterior margin straight to median rounded tooth with small median notch and with a notch either side of tooth about as deep as half width of lobe. Pygofer of male about rectangular with short stout hook on outer ventral corner; aedeagus with broad more or less rectangular base, longer than length of shaft. Shaft less than half as wide as basal portion, slightly curved dorsally and opened at apex; sheath-like processes apparently arising from basal portion, each one much broader than shaft of aedeagus forming an enclosing sheath, ending in sharp point slightly before apex of shaft.

Holotype male, *allotype* female, 7 male and 9 female *paratypes*, Cedarvale, Kansas, May 26, 1937, R. H. Beamer. Other *paratypes* as follows: 5 males and 4 females, Ottawa, Kansas, October 1, 1925, E. P. Breakey; 2 males and 6 females, Greenwood County, Kansas, August 2, 1923, Beamer and Lawson. Types in Snow Collection, University of Kansas.

*Contribution from the Department of Entomology, University of Kansas

Mesamia infusata n. sp.

Resembling *M. vermiculata* but darker, vertex more angulate and aedeagus with processes narrow, not sheath-like. Length 4.5–4.75 mm.

Vertex margins meeting at more than a right angle, two-fifths wider between eyes than length at middle.

Color. Yellowish gray to semihyaline; veins dark brown; dorsum usually suffused with fuscous. Vertex margin white, lined above and below with dark, that above broken at middle; disc more or less evenly colored with fuscous or buff, sometimes with green; pronotum with anterior margin lighter, remainder dark mottled; scutellum with basal angles darker, usually golden brown; elytra with veins dark brown, with many vermiculate spots and lines in clavus and half of corium next claval suture; costa lighter, recurrent veins variable in number and very dark; venter mottled with light and dark.

Genitalia. Last ventral segment of female twice as long as preceding; lateral margin fairly angular, posterior margin shallowly excavated to a rounded median tooth with a sharp notch either side, embrowned beneath each notch. Male pygofer about rectangular, with short hook on outer ventral corner; aedeagus with basal part almost square in lateral view, shaft bent dorsally in half circle, tip enlarged, pair of lateral processes arising near base, more or less parallel to shaft, slightly diverging, narrowing to sharp apices near end of shaft.

Holotype male, *allotype* female, 5 male and 3 female *paratypes*; Cloudcroft, New Mexico, June 27, 1940; and 1 male and 11 female *paratypes*, Ruidosa, New Mexico, June 26, 1940, R. H. Beamer. Types in the Snow Collection, University of Kansas.

Mesamia retusa n. sp.

Resembling *M. infusata* but vertex more blunt and aedeagus with basal part in lateral view almost twice as long as wide. Length 4–5 mm.

Vertex quite blunt especially in male, nearly one-half longer between eyes than length at middle, margins rounded, meeting at quite an obtuse angle.

Color. Yellowish gray, veins dark; vertex margin light, bordered with dark continuous line below, and line broken medianly above; disc often darker; pronotum mottled, anterior margin lighter; scutellum buff, basal angles darker; elytra grayish semihyaline, veins dark brown with more or less ramose pigment lines and spotting on mesal half. Females much lighter colored throughout.

Genitalia. Last ventral segment about twice as long as preceding; lateral margins rounded, posterior margin roundly excavated on median third, with a V-shaped notch either side of a blunt wedge-shaped median tooth extending out even with edge of segment on either side. Pygofer of male almost square with sharp tooth on outer ventral corner, about one-third as long as width of pygofer. Aedeagus in lateral view with basal portion about twice as long as broad; shaft scarcely as long as basal portion, curved dorsally, with apex enlarged; lateral processes arising near base of shaft, narrow, extending with shaft, separating in dorso-ventral view to end near apex of shaft.

Holotype male, *allotype* female; 2 male and 1 female *paratypes*, Strawberry, California, August 8, 1929; 1 male *paratype* each, Yosemite National Park, California, August 1, 1940; Mint Canyon, Calif., July 6, 1932, R. H. Beamer. In Snow Collection, University of Kansas.

DESCRIPTIONS OF NEW TRICHOPTERA FROM THE UNITED STATES

BY DONALD G. DENNING,

University of Minnesota, St. Paul, Minn.

A study of recently collected Trichoptera in the University of Minnesota Collection has yielded a number of new species. Several of these new species are described in the following paper. The types of all the new species described herein are deposited in the University of Minnesota Collection, unless otherwise stated.

***Eomystra unlea* n. sp.**

This is the first time that this recently described genus has been recorded from North America. This species, the second described in the genus, was collected in northeastern Minnesota, near Lake Superior, by Mr. H. Page Nicholson of the University of Minnesota.

The genus *Eomystra* was described by A. B. Martynov in 1934. The writer is indebted to Dr. A. A. Granovsky of the University of Minnesota for the translation of the original description from the Russian. Martynov's description of the genus is as follows.

"Spurs 1 (2), 4, 3; in anterior legs the inner spur is quite rudimentary and usually indistinct; in male the inner apical spur of the posterior legs is much shorter than the outer, but thicker and furcated at its end; middle legs in female strongly dilated. Venation of wings as in *Glossosoma* Curt.; in the forewings of male A_2 is strong and straight, A_3 and A_4 fused in one thick vein, running in its basal part near to the ano-jugal fold; false vein short, knee-shaped as in *Glossosoma*; around it a brownish oval spot is situated.

"Male genital segments and appendages symmetrical, pedes genitales composed of two branches as in *Mystrophora*. Genus close to *Mystrophora* but distinct."*

This genus was based on the description of a single new species, *Eomystra dulkeji* Martynov, with the distribution given as follows: "Found only on large Shantarski Island by Dulkejt (δ and η). Doubtless lives in rivers and streams of mountainous character." This island is located near the eastern coast of Siberia, in the Sea of Okhotsk, latitude 55° .

The Minnesota species can be readily separated from the previously described member of the genus by the genitalia and the modified spur.

Male. General color of head, body and wings uniformly brownish; coxae brownish, remainder of legs straw colored. Antennae brownish, distinctly annulated with yellowish color, shorter than wings, basal segment about three times length of second and considerably darker than remainder of segments. Maxillary palpi with first two segments short, second segment bulbous and slightly shorter than first, each bearing long stout black setae, third segment about length of fifth, fourth slightly shorter than either, all covered with rather dense short setae. Venation similar to *Mystrophora* except as follows: in fore wing R_1 not fused to Sc during any part of length; in hind wing R_3 branches from $R_2 + 3$ near margin of wing, making cell R_2 pedicellate. Callosity in anal area of fore wing well defined, considerably rougher than remainder of wing and slightly lighter in color. Spurs 2, 4, 4; spurs of fore legs prominent, each about same length. Modified inner spur of third pair of legs prominent, slightly more than one-half the length of the outer spur, broad at base, gradually tapering to a sharp spine which is sharply angled toward a dense group of closely appressed setae, these setae originate near angle of spur and project in a fan-like group slightly beyond apex of spur, fig. 1B. Femur of fore legs, and femur

*Martynov, A. B., Trichoptera Annulipalpia, Leningrad, 1934.

PLATE VI.



EOMYSTRA UNICA



2a



2b



2

LIMNAPHILUS AGROCURVUS



3a



3

ATHRIPSOIDES ARIELLES



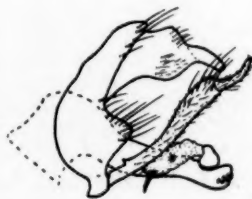
4a



5a



6a



4



5



6

HYDROPSYCHE RIOLA

CHEUMATOPSYCHE MICKELI

CHEUMATOPSYCHE ELA

GENITALIA OF TRICHOPTERA

and tibia of middle and posterior legs strongly dilated; basal joints of tarsi dilated to a lesser degree, legs covered with short dark setae.

Genitalia as in fig. 1, 1A. Abdomen of male with a large ventral plate on segment six, and a small ventral tooth on segment seven. Ninth segment with dorsal portion twice as long as ventral portion, dorsal half extending beyond basal portion of clasper; dorsally rather dense stout setae present. Clasper with basal portion about as wide as narrowed portion of ninth segment; divided into a dorsal and ventral lobe, the ventral lobe sinuate, cylindrical, gradually tapering to a slender point, a few long stout setae along ventral margin; dorsal lobe shorter than ventral, dorsal margin irregular, apex enlarged, apical portion bearing a few long stout setae. Viewed ventrally basal portion of clasper extended laterally into a thin, wide, slightly concave plate, caudal surface bearing a considerable number of long stout setae; ventral and dorsal lobes of clasper arise from ventro-mesal and dorso-mesal angle respectively. Tenth tergite viewed dorsally, fig. 1A, composed of two lateral plates, apical portion gently curved ventrad, outer margin slightly flexed dorsad, this margin forming a well defined ridge along lateral aspect of tergite; seen from lateral view the base wide, declivous at apex; quite heavily clothed with stout setae. Aedeagus short, narrow, plates heavily sclerotized.

Holotype. Male; Cook County, Minnesota, Temperance River, May 30, 1941, H. P. Nicholson.

***Limnephilus aerocurvus* n. sp.**

Length 9.5 mm. Color of head, thorax, abdomen, coxae and femora dark brown; tibia and tarsi straw colored. Membrane of wing straw colored, except a small dark spot along M_{1+2} ; setae on wing veins sparse and black, only a few scattered black setae on remainder of wing. Tibia with spur formula 1-3-4, spurs yellowish, spines dark brown. Front basitarsus almost one and one-half times the length of the next segment. General structure places this species in the *Anabolina* section.

Genitalia as in fig. 2, 2A, 2B. Eighth tergite with prominent meso-apical projection covered with dense short setae. Ninth segment greatly widened in the middle, suddenly constricted to a narrow collar dorsally. Lobes of tenth tergite thin and wide, ventral angle rounded, the dorsal portion produced into an acute apex directed dorsad. Claspers greatly reduced, triangular, angled gently mesad; they are set off from the ninth segment by a faint suture and covered with a few long setae. When viewed laterally, fig. 2, cerci are triangular, the length about one and one-half times the base; actually the apical portion of the cerci are curved sharply mesad, projecting mesad over lobes of tenth tergite, fig. 2A. When viewed caudally ventral and posterior margins of each lobe of the tenth tergite and posterior margin of the cerci form two large circles. Aedeagus with central portion simple; lateral arms, fig. 2B, with apex produced into a slender point covered with dense short setae.

Holotype. Male; Crow Wing County, Minnesota, Gull Lake, May 18, 1941, G. Kretschmar.

***Athripsodes arielles* n. sp.**

This species belongs to the *dilutus-annulicornis* group, and can be readily differentiated from described members of that group by the digitate lobe of the clasper in addition to other details of the genitalia.

Male. Wing expanse 18 mm. Antennae about twice the length of the wings; each segment brown with a white ring around basal portion, these rings diminish in size from base to apex until the tip of the antennae is uniformly brown. Wings with membrane brown except a small white spot at tip of anal veins and a small subapical fringe of white hairs along margin of wing extending

nearly to *M.*. Legs cream colored, each joint of tarsi tipped with brown. Pubescence of head and thorax white with a few black hairs. Eyes small; dorsally separated by about three times the distance of their dorsal length.

Genitalia as in fig. 3, 3A. Ninth segment quite similar to *alces* Ross, but basal portion much wider. Cerci similar to *annulicornis* (Stephens), triangular, indistinctly separated from ninth segment; apical portion with a few fine setae. Tenth tergite with apex strongly upturned, apical margin nearly straight. Clasper with basal segment slightly directed caudad, the basal portion produced into a small quite blunt point; the apical segment semi-membranous, finger-like and directed caudad, with a peripheral row of stout setae; digitate lobe almost as long as apical segment of clasper, directed caudad apex almost circular when viewed caudally. Aedeagus short and stocky, a single large spine present internally.

Female. Very similar in size, color and general characteristics to the male.

Holotype. Male; Anoka County, Minnesota, Coon Creek, June 7, 1937, D. G. Denning.

Allotype. Female; same data as for holotype, except June 5, 1937.

Paratype. 1 male, same data as for holotype (abdomen damaged).

Hydropsyche riola n. sp.

This species is very closely related to *alhedra* Ross. It can be separated from that species by the gradual ventral curve of the tenth tergite prongs and also in details of the aedeagus. Dr. H. H. Ross has compared this species with *alhedra* Ross and states that it is closely related to that species.

Head and thorax light brown; rather dense covering of short closely appressed silvery setae and long dark setae tipped with silver on dorsum of head, prothorax and mesothorax. Antennae annulate with yellowish and dark brown. Front wings with irregular flecking of brown and silvery setae resulting in a very striking pattern of silvery setae against a dark background; hind wings grayish, apex slightly darker.

Genitalia as in fig. 4, 4A. Ninth segment annular, the lateral projection bluntly triangular, the dorsal portion distinctly set off from the tenth tergite. Tenth tergite similar to *alhedra* Ross except pair of blade-like lobes at apex tapering gradually ventrad, not nearly as sharply turned ventrad as in *slossonae* Bks. Aedeagus sinuate, the broad base forming an almost right angle to remainder. Lateral processes arising from mesal plates provided at tip with a stout sharp spine, no pocket of small spicules at base of spine as in *alhedra* Ross; a secondary pair of lateral arms bearing three short stout spicules arise from the main lateral processes at a height about even to the dorsal margin of the aedeagus. Seen from the ventral view these lateral arms appear as in fig. 4A. Apical bulb of aedeagus with an internal pair of pockets of extrusible spicules.

Holotype. Male; Hennepin County, Minnesota, Nine Mile Creek, May 5, 1937, Donald Denning.

Allotype. Female; Savage, Minnesota, Credit River, reared, April 2, 1940, D. G. Denning.

Paratypes. Minnesota. Hennepin County, Nine Mile Creek, reared, May 6, 1937, D. G. Denning, 1 ♂; Savage, Credit River, reared, May 11, 1935, D. G. Denning, 2 ♂; Savage, Credit River, April 2, 1940, reared, D. G. Denning, 4 ♂, 3 ♀; Olmsted County, C. N. Ainslie, 1 ♂; Fertile, Polk County, May 22, 1941, D. G. Denning, 2 ♂, 1 ♀; Fertile, Polk County, August 29, 1941, D. G. Denning, 1 ♂.

One male paratype is deposited in the collection of the Illinois Natural History Survey of Urbana, Illinois.

Cheumatopsyche mickell n. sp.

The genitalia of this species bear some resemblance to *burksi* Ross, but it can be readily separated from that species by the lateral lobes of the tenth tergite as well as several other details of the genitalia.

Male. Length 7 to 8 mm. General structure typical for genus. Head, thorax and abdomen dark brown; legs straw colored; antennae yellowish-brown, the five basal segments of flagellum with a dark brown dorsal V-mark. Front wings uniformly dark brown, a few inconspicuous light spots along apical margin.

Genitalia as in fig. 5, 5A. Ninth segment annular, the dorsal lobes prominent and bearing a peripheral row of long setae. Tenth tergite indistinctly set off from the ninth, a narrow elongate wart bearing long setae on lateral aspect near ventro-caudal angle; apex produced into a distinct mesal point, lateral lobes arise on either side, viewed laterally these lateral lobes project slightly dorsad of mesal point. Viewed caudally, fig. 5A, lateral lobes with a distinct lateral angulation about midway between apex and base, in one specimen examined lateral angulation very small; apical portion of lobe quite wide, somewhat elliptical in shape; base narrowed; a scattering of small setae present. Clasper slightly thickened toward middle and again at apex; apical segment about one-third the length of the basal one, base broad tapering to a slender slightly curved apex, a rather heavy covering of setae on caudal portion. Aedeagus slender, very similar to other members of the genus.

Female. Very similar in size and general characteristics to male.

I take pleasure in naming this species in honor of Dr. C. E. Mickel who has collected Trichoptera extensively in many parts of this country and has thereby added much to the knowledge of this group.

Holotype. Male; Morgan Hill (Santa Clara County), California, August 8, 1941, light trap, Roland Johnson.

Allotype. Female; same data as for holotype.

Paratypes. California. Morgan Hill (Santa Clara County), September 7, 1939, at light, C. E. Mickel, 1 ♂; Morgan Hill (Santa Clara County), August 8, 1941, light trap, Roland Johnson, 9 ♂, 1 ♀.

Cheumatopsyche ela n. sp.

Superficially this species is very similar to *campyla* Ross but can be separated from it in several genitalic differences, especially in the greatly widened base of the lateral processes at the apex of the tenth tergite.

Male. Length 8 mm. Head and thorax brownish, legs straw colored, antennae yellowish brown. The five basal segments of the flagellum with a distinct dark brown V-mark; in one specimen two dorsal V-marks on first segment of flagellum. Front wings light brown with an abundance of dark flecks over entire wing giving a darkened appearance to the wing; hind wings a trifle lighter in color. Inner apical spur of middle leg about two-thirds length of outer, somewhat flattened; spurs covered with dark brown setae. Tarsal segments covered with rather dense dark brown flattened setae so that the tarsal segments have a blackened appearance.

Genitalia as in fig. 6, 6A. Ninth segment annular, produced dorsally into a pair of prominent lobes bearing long setae along apical margin. Tenth tergite with ventro-caudal angle extended ventrad; apex produced into a pair of lateral lobes which project slightly dorsad of dorsal margin. Viewed caudally, fig. 6A, lateral lobes with base very wide, lateral margin rounded; apical portion greatly constricted, apices blunt, slightly divergent, barely touching along their mesal margins; setae covering apical portion quite long, curved caudad. Claspers with basal segment slightly more than three times length of apical segment, apical

segment slender, curved cephalad, considerably thinner than in *campyla* Ross. Aedeagus typical for genus.

Holotype. Male; Ela, North Carolina, May 30, 1941, S. S. Easter.

Paratype. 1 ♂; same data as for holotype.

A NEW CERAMBYCID BEETLE FROM OREGON (COLEOPTERA)

BY W. S. FISHER,

Bureau of Entomology and Plant Quarantine, Washington, D. C.

In a small collection of Coleoptera received for identification from Borys Malkin, the following new species was found.

Phymatodes malkini n. sp.

Piceous, except antennae, legs in part, base of thorax, mesosternum, metasternum, and triangular basal area of elytra, which are yellowish brown.

Head flat in front, very finely granulose, not distinctly punctate, opaque, sparsely clothed with long, erect hairs. Antenna as long as body in male, three-fourths as long as body in female, sparsely clothed with short, recumbent and long, erect hairs; second segment slightly longer than wide and one-half as long as third; third segment slightly shorter than fourth, the following segments each slightly longer than fourth and subequal in length.

Pronotum subequal in length and width, slightly narrower than elytra; sides arcuately rounded near middle, gradually constricted toward base and apex, parallel at base; disk convex anteriorly, narrowly, transversely depressed along base; surface very finely granulose, not distinctly punctate, opaque, with a few long, erect hairs.

Elytra twice as long as wide; sides nearly parallel; surface indistinctly granulose, sparsely clothed with rather long, recumbent hairs (reddish brown on piceous areas and yellowish on yellowish-brown areas), with a few long, erect hairs intermixed, and each elytron ornamented with a narrow, oblique fascia of dense, recumbent, white hairs in front of middle extending from lateral margin to near sutural margin, and the apical third sparsely clothed with recumbent, white hairs, forming a more or less distinct, broad, oblique fascia anteriorly.

Body beneath moderately shining, sparsely clothed with short, recumbent and long, erect hairs intermixed. Tarsal segments broad and globose in male, narrow and slender in female.

Length 7 mm., width 2 mm.

Type locality. Eugene, Oregon.

Type and allotype. In the United States National Museum, No. 55901. Paratype in the collection of Borys Malkin.

Described from three specimens, two males and one female (male type), collected June 29, 1941, on flowers on the slope of Baldy Mountains (Coburg Hills), five miles northeast of Eugene, Oregon, by Borys Malkin.

This species is allied to *Phymatodes funebris* Van Dyke, but it differs from the description given for that species in being smaller, in having the bases of the thorax and elytra yellowish brown, the pronotum clothed with a few long, erect hairs, and not distinctly punctate, the base of the elytra not clothed with grayish pubescence, and the tarsal segments of the male broad and globose.

NEW DESCRIPTIONS OF LARVAE OF FOREST INSECTS,
III, *ZANCLOGNATHA*, *PALTHIS*, AND *AUTOGRAPHA*, (LEPIDOPTERA,
PHALAENIDAE)*

BY A. W. A. BROWN AND W. C. MCGUFFIN,
Ottawa, Ontario

Zanclognatha minoralis Sm.

Plate VII, a

Penultimate Instar. Head width 1.0 to 1.3 mm. Body length 7 to 10 mm. Otherwise similar to ultimate instar.

Ultimate Instar. Head width 1.3 to 1.5 mm. Body from 9 to 11 mm. long and from 1.5 to 1.7 mm. wide; shape subcylindrical, broadest at first abdominal segment, eighth abdominal segment with a dorsal swelling; skin densely covered with minute conical granules; ground colour pale yellow, cream-coloured, or greyish-white, heavily mottled with dark brown, dark grey, or ruddy-brown, often with a pink suffusion, venter lightly tinged with reddish-brown or even green. Head dark grey, greyish-brown, or greyish-yellow, covered with minute convex granules; vertex coloured with distinct dark brown reticulation; frons often more lightly pigmented than adfrontals, which latter possess sinuate lateral margins, giving them a narrow anterior section and a broad indented posterior section, and thus resemble in outline an old-fashioned pair of dividers; epicranial index 0.6 to 0.8; preclypeus pearly white and wrinkled, its median longitudinal width 6 times that of the deeply concave postclypeus; labral cleft quite deep, at an angle of 120 degrees, with a groove extending dorsad to postclypeus; distance between ocelli 1 and 2 is one-half to two-thirds that between ocelli 2 and 3, a band of solid brown coloration running from ocellar area to tip of adfrontals. Cervical shield distinct, granular, grey or greyish-cream to greyish-brown, with dark spots marking setal bases. Anal shield granular, grey-green to dark grey, with darker mottlings, the projections bearing setae giving its posterior edge a scalloped appearance. Setigerous tubercles composed of black conical papillae borne on conspicuous dark projections or chalazae. Spiracles broadly elliptical, yellow to brown, with heavy dark rims. Thoracic legs grey to greyish-brown, their coxae sometimes tinged with green. Abdominal legs dirty green to grey, each anterior proleg with 15 to 20 uniordinal crochets. Ventral prothoracic gland present.

Mandibles with 5 subequal teeth, the fifth truncate, the remainder rounded, and a low internal tooth on the first ridge (Fig. 2). Hypopharynx with lingua occupying one-half its length, heavily studded with stout spines, the gorge narrow and bare, the lobes set with long retrorse spines. Spinneret 4 times as long as broad. Labial palpi with the segments in the proportion of 10:3:10.

This species feeds externally on the foliage of black and white spruce.

Palthis angularis Hbn.

Plate VII, b

Penultimate Instar. Head width 1.2 to 1.3 mm. Body about 7 mm. long and 1.5 mm. wide. Similar to ultimate instar, except that the dorsal obliques are not edged with yellow.

Ultimate Instar. Head width 1.4 to 1.7 mm. Body 10 to 12 mm. long and 2.0 to 2.5 mm. wide; tapering regularly cephalad and caudad of the first abdominal segment, the eighth abdominal segment with a dorsal swelling; skin

*Contribution No. 2119 from the Division of Entomology, Science Service, Department of Agriculture, Ottawa. This is the third of a series of contributions from the Canadian Forest Insect Survey.

PLATE VII.



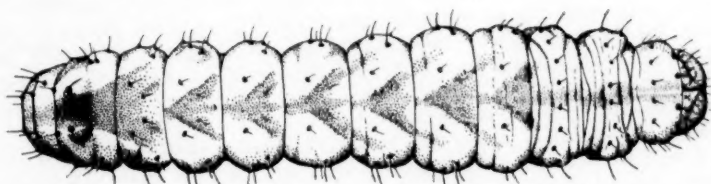
2mm.

a



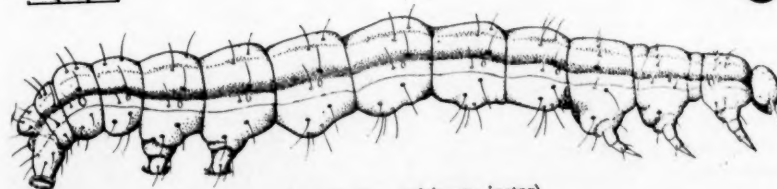
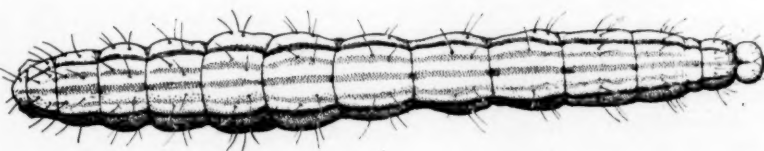
2mm.

b



3mm.

c



- a, Larva of *Zanclognatha minoralis* Sm. (ultimate instar).
 b, Larva of *Palthis angulalis* Hbn. (ultimate instar).
 c, Larva, of *Autographa selecta* Wlk. (ultimate instar).

set with coarse well-separated granules, which are conical, distinctly pointed, and retrorse; ground colour ruddy-brown, with a faint narrow middorsal line, the abdominal segments marked with dark dorsal oblique bands meeting at the posterior edge of each segment and pointing backwards (on abdominal segments 1 and 8 the coloration is solid between the obliques), bordered laterally with yellow; the dark spiracular line consisting of a series of segmental obliques directed downwards and backwards; venter of ground colour. Head light brown covered with minute convex granules, and marked with distinct dark brown reticulations; frons lighter in colour and faintly tinged with pink at apex, coloration of adfrontals much lighter laterally than medially; the epicranial index 0.7; preclypeus concolorous with frons, 3 to 5 times the median longitudinal width of the postclypeus, its ventral margin concave; labrum dark brown, its cleft deep and at a right-angle; distance between ocelli 1 and 2 is one-half that between ocelli 2 and 3 (occasionally more), pedicel of antenna with a pink suffusion. Prothoracic shield of ground colour, the dorsal line broadened, and the conical granules rounded. Anal shield also of ground colour, the dorsal line continued to its posterior edge. Setigerous tubercles conical, brown, composed of a small pale papilla borne on a small but elevated, decidedly dark, projection or chalaza; the setae short, translucent light brown. Spiracles broadly elliptical, brown with heavy dark rims. Thoracic legs light brown, slightly darker at tip. Abdominal legs dirty grey, their lobes sometimes tinged with pink; crochets on anterior prolegs uniordinal, numbering from 18 to 22. Ventral prothoracic gland present.

Mandibles with 5 teeth, the first very small, the fifth truncate, the remainder wedge-shaped, and with two ridges and one low internal tooth (Fig. 3). Hypopharynx stout and convex, with lingua occupying two-thirds its length, heavily set with stout retrorse spines, gorge broad and bare posteriorly, lobes with spines thinning out posteriorly (Fig. 4). Spinneret about twice as long as broad, the tip blunt with a median apical notch. Labial palpi with segments in the proportion of 12:2:10.

P. angulalis feeds on white, black, Englemann and Sitka spruce, and also on balsam fir; we have records also of white and gray birch, sugar maple and choke cherry as host trees.

Autographa selecta* Wlk.

Plate VII, c

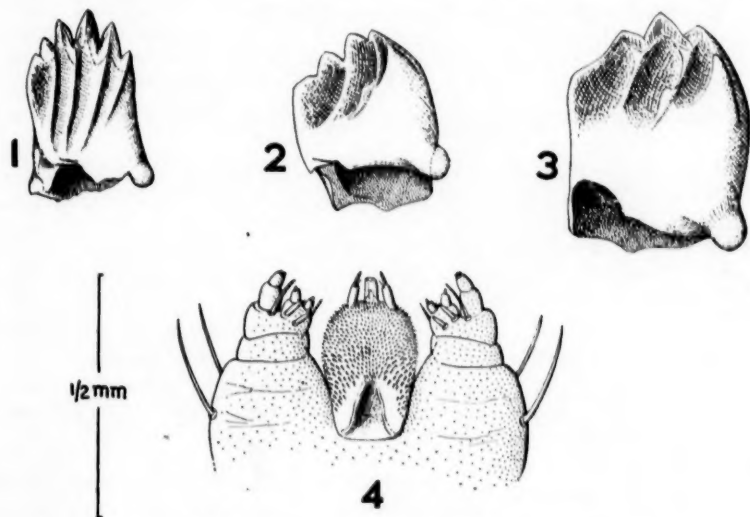
Overwintering (probably third) Instar. Head width about 0.9 mm. Body from 7 to 9 mm. long and from 1.0 to 1.5 mm. in width; cylindrical in shape; skin densely covered with black conical granules, even on prolegs and venter; ground colour dark green with broad white addorsal lines, narrow white subdorsal lines, and very broad white spiracular lines, the venter dull green. Head shiny, light brownish-green, in most cases mottled with dark brown; epicranial index 1.0 to 1.3; preclypeus colourless and translucent, its ventral margin broadly concave, about four times the median longitudinal width of the postclypeus; labral cleft broad and obtuse; distance between ocelli 1 and 2 is twice that between ocelli 2 and 3. Cervical shield medium green, shiny and lacking the conical granules in its middle section. Setigerous tubercles composed of black and slightly convex papillae, set in the centre of conspicuous black pinnacula, the setae dark, long and stout. Spiracles circular to elliptical, greenish-white at centre and with a light brown rim; those on the prothorax and the eighth abdominal segment are about 3 times the size of the others. Thoracic legs green, brown distally. *Two pairs of abdominal legs*, which are medium green and not

**Autographa* alias *Otol.* and *Autographa* *rectangula* Kby. are at present indistinguishable from this species.

sclerotized, even at the lobes. This is the last larval instar seen before hibernation.

Antepenultimate Instar. Head width 1.3 mm. Body about 11 mm. long and 1.5 mm. wide. Ground colour dark green, the venter very dark green due to a dense covering of black conical granules. Head light brownish-green. Black circular spots around setigerous tubercles are all large and conspicuous. Otherwise similar to ultimate instar.

Penultimate Instar. Head width 1.7 to 1.8 mm. Body from 14 to 15 mm. long and 1.8 to 2.0 mm. wide. Ground colour dark to medium green. Head still occasionally brownish-green, otherwise medium green. Circular black spots around setigerous tubercles still large, except around setae alpha in the middle segments; setae still very conspicuous. Otherwise as in ultimate instar.



Mandible of *Autographa selecta* Wlk. (Fig. 1), *Zanclognatha minoralis* Sm. (Fig. 2), and *Palthis angulalis* Hbn. (Fig. 3). Hypopharynx of *Palthis angulalis* Hbn. (Fig. 4).

Ultimate Instar. Head width 1.9 to 2.0 mm. Body from 16 to 21 mm. long and from 2.5 to 3.0 mm. wide; tapering gradually anteriorly from the fifth abdominal segment, and more rapidly posteriorly from the sixth; ground colour medium to light green, the green middorsal line flanked by broad white addorsals, below these an equal width of ground colour bordered by the narrow white subdorsal lines; spiracular line broad, coloured white, cream or white edged with yellow dorsally, supraspiracular line dark green suffused with the black of the conical granules, the spiracles lying towards the dorsal edge of the spiracular line; venter clear to dirty green, often yellowing in the middle of each segment. Head smooth, clear medium to light green, without markings; epicranial index 1.1 to 1.3; distance between ocelli 1 and 2 is twice that between 2 and 3; preclypeus smooth and colourless, its median longitudinal width 4 times that of the postclypeus, its distal margin concave; labrum deeply cleft at angle of 100 degrees. Prothoracic shield indistinct, clear or medium green, the subdorsal lines present but the addorsals absent; anal shield similar. Setigerous tubercles consisting of black and slightly convex papillae; setae dark and conspicuous. Spiracles colourless with narrow light brown rim, those on the prothorax and eighth abdominal segment 3 times

the size of the others. Thoracic legs medium green, brown distally. Two pairs of abdominal legs, vivid medium green to dark green browning at the crochets, which number 22 to 26 on the fifth abdominal segment. Ventral prothoracic gland present, conspicuously long.

Mandibles thin and flat with 6 pointed teeth, the sixth appressed to the fifth, and 3 ridges, lacking any internal tooth (Fig. 1). Hypopharynx with lingua bearing a few very stout spines on its posterior portion, the gorge bare except for a few scattered retrorse spines, the lobes set with long coarse spines directed towards gorge. Spinneret 4 times as long as broad, its tip bluntly rounded. Labial palpi with segments in the proportion of 15:3:15 in some cases, and 18:3:25 in others.

All three species of *Autographa* mentioned feed on white and black spruce: *A. rectangula* on balsam fir in addition, and *A. selecta* also on Engelmann spruce, balsam fir, Douglas fir, white pine, and lodgepole pine.

NOTE

MANDIBULAR SHAPES IN WATER BEETLES OF THE GENUS *THERMONECTUS* (COLEOPTERA, DYTISCIDAE)

In his valuable paper on water beetles in relation to pondfish culture*, Wilson described the immature and adult stages of two species of *Thermonectus*, *basilaris* (Harris) and *ornaticollis* (Aubé). Since the latter had been cited as a mere variety of *basilaris* by Leng and Mutchler, 1918, Wilson listed the differences between the two species, and illustrated the distinctive mandibles of the adults (Figs. 55, 56).



Mandibles of *Thermonectus*.

Examination of both sexes of the Nearctic species of *Thermonectus* shows that in all cases the right mandible has a ligulate tooth (Fig. 2; Wilson's Fig. 55, of *basilaris*), while the left has a broad and nearly rectangular tooth (Fig. 1; Wilson's Fig. 56, or *ornaticollis*). There do not appear to be any significant differences in the mandibles of the species dissected.

Hugh B. Leech,
Vernon, B. C.

*Wilson, C. B., 1923, Water beetles in relation to pondfish culture, with life histories of those found at Fairport, Iowa. Bull. Bureau Fisheries, 39:231-345, 148 figs. Document No. 953. (*Thermonectus*, pp. 291-298, Fig. 52-74).

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